

BUILDING COMMISSIONING

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CASE STUDY

BELLINGHAM TECHNICAL COLLEGE — RETRO-COMMISSIONING IDENTIFIES INDOOR AIR QUALITY SOLUTIONS



College Services Building

Since first being occupied in 1994, the College Services Building at Bellingham Technical College had been plagued with indoor air quality (IAQ) problems. Several retrofits over the years were unsuccessful in fixing the problem. This 2-story office building houses the college's executive staff, registration, and career center.

In early 1999 the college, in conjunction with the Washington State Department of General Administration's building commissioning program, hired Keithly Welsh Associates to assess the IAQ problems and recommend potential solutions. Phase 1 of the project included physical inspection and functional testing of the existing heating, ventilating and air conditioning system (HVAC).

The college acted on all of the commissioning agent's recommendations, obtaining capital funding for Phase 2 (retrofitting the HVAC), which was completed in 2003. Keithly Welsh also provided commissioning services for the Phase 2 work.

COMMISSIONING QUICK FACTS

Building Name	College Services Building, Bellingham Technical College
Location	Bellingham, Washington
Project	Assess, repair and replace HVAC system components to address indoor air quality issues
Commissioning Scope	Evaluation of existing HVAC (Phase 1—retro-commissioning), followed by commissioning of new equipment and systems (Phase 2—construction)
Size of Commissioned Area	20,000 square feet
Total Commissioning Cost	\$18,380 (Phase 1). \$15,200 (Phase 2)
Commissioning Cost per Square Foot	\$0.92 (Phase 1). \$0.76 (Phase 2)
First-Year Cost Benefit	\$3,700
Annual Energy Savings	\$2,900 per year

PROJECT PARTNERS

**Washington State
Department of General
Administration**
Roger Wigfield

**Bellingham Technical
College**
Kathryn Longfellow

Keithly Welsh Associates
(Commissioning Agent)
Bryan Welsh

Henry Kline Partnership
(Phase 2 Architect)
Julie Blazek

Berona Engineering
(Phase 2 Design Engineer)
Melchor Berona

"The Administration building had been plagued with occupant complaints of air quality since its opening.... [The] commissioning study ... analyzed the entire building and all its components and noted the various issues...[and] provided the background for a project that involved the cooperative efforts of a mechanical engineer, commissioning consultants, architect, owner, contractor and sub-contractors. This project greatly enhanced the indoor air quality of the building."

Kathryn Longfellow
Vice President,
Administrative Services
Bellingham Technical College

PROJECT SCOPE OF WORK

Phase 1 of the project included physical inspection and functional testing of the existing HVAC system, including:

- 2 variable-volume/variable-temperature (VVT) rooftop air handling units
- 30 VVT terminal units
- HVAC control system
- 2 building relief fans with associated controls

During Phase 2 the commissioning agent provided input to design of the new HVAC systems, verified functionality of the repaired and new systems, and resolved remaining Phase 1 issues.

ISSUES IDENTIFIED

Phase 1 revealed a significant number of deficiencies related to design, installation, construction, maintenance, and operation of the existing HVAC system. The original design intent could not be achieved primarily because of temperature and air flow issues due to system selection, zoning choices, system sizing choices, and return air restrictions caused by conflicts between the building structure and the HVAC design.

Phase 1 resulted in the following recommendations, all of which were implemented:

1. Remove restrictions to return air path.
2. Replace the by-pass dampers on roof-top air handling units (dampers had not been sized or installed correctly).
3. Install auxiliary exhaust fans with variable speed drive (existing fans were not installed correctly and contributed to building pressure problems).
4. Replace terminal units with variable air volume (VAV) units with electric reheat.
5. Install new control system.
6. Repair rooftop air handling units (RTU).
7. Repair miscellaneous issues including holes in ductwork, grilles blocked with cardboard, access issues, incorrect labeling, and missing insulation.
8. Re-balance HVAC system.

During commissioning of Phase 2, additional issues were identified and corrected, including:

- Incorrect configuration of the RTU controls was causing terminal units to run in unoccupied mode.
- Variable air volume units did not go into heating mode during failure of RTU heating.
- RTU duct static pressure control dead band was too large, resulting in sloppy control.
- Some VAV boxes were not providing heat.

ENERGY IMPLICATIONS OF COMMISSIONING

The primary objective of the retro-commissioning project was to improve air quality. However, because the solution included a retrofit of the HVAC and control system, Phase 2 commissioning identified a number of issues that, if they had not been corrected, would have resulted in increased energy consumption. Among the issues were:

- A thermostat was located over a heat source, forcing the RTU into a continuous call for cooling, and causing remaining zones to reheat unnecessarily.
- Morning warm-ups were designed to be handled by the gas-fired RTU. However, electric heating was not locked out during this time, impacting electric utility demand charges.
- The RTU outside air dampers were at minimum position during morning warm-up, when they should have been closed.
- The RTU outside air sensors were reading higher than reference standard, causing free cooling to be locked out prematurely.
- The auxiliary relief fan dampers did not close during the unoccupied mode, causing heat loss due to natural convection.
- The unoccupied high limit on one RTU brought the heating on instead of cooling.

ADDITIONAL BENEFITS

The retro-commissioning process revealed that the original design and construction were not properly executed, demonstrating the need for facility commissioning at the time of construction. As a result of this and other successful retro-commissioning projects, commissioning of new facilities at the college will become a routine part of future projects.

PROJECT BENEFITS

- \$3,700 in first-year cost benefits (such as improved indoor air quality, improved occupant comfort, etc.)
- \$2,900 in annual energy savings
- Improved indoor air quality
- Thermal comfort and reduction in noise from HVAC

"Keithly Welsh Associates... worked closely with Berona Engineers to design the right solution and see that it was installed properly."

Julie Blazek
Senior Associate
The Henry Klein Partnership



Rooftop air handling unit and exhaust fan

FOR INFORMATION ON WASHINGTON'S COMMISSIONING PROGRAM



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WHAT IS COMMISSIONING?

Building commissioning is a systematic and documented process of ensuring that building systems perform according to the design intent and the owner's operational needs.

Commissioning is used in both new construction and existing buildings.

Commissioning:

- Provides a better environment for occupants
- Reduces indoor air quality problems
- Reduces occupant complaints
- Reduces contractor call-backs and warranty issues
- Reduces energy consumption and operational costs

Technical Writing/Editing

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